PRISM® 11Mbps Wireless Local Area Network Access Point

The Intersil ISL36356A WLAN Access Point is a complete wireless high speed Network Access Point (AP) utilizing the Intersil PRISM® AP Direct Sequence Spread Spectrum Wireless Transceiver chip set. It provides a complete PRISM reference design platform of hardware and software to system providers or integrators requiring wireless data communications capability. The Open Source Linux operating system offers a flexible and extensible development platform for making customized Access Points and Gateways.

The Developers Kit includes a WLAN Access Point reference design, configuration application, source code and documentation. It supports the IEEE802.11b network specification for Direct Sequence Spread Spectrum DSSS signaling, providing data rates of 1, 2, 5.5 and 11Mbps. Typical operating ranges are shown in Table 1.

TABLE 1. TYPICAL OPERATING RANGE*

DATA RATE (Mbps)	INDOOR RANGE	OUTDOOR RANGE
11	120 feet (37 meters)	500 feet (152 meters)
5.5	200 feet (61 meters)	800 feet (243 meters)
2	240 feet (73 meters)	1300 feet (396 meters)
1	300 feet (91 meters)	1750 feet (533 meters)

* The range will vary in different operating environments due to effects such as building construction.

Ordering Information

PART NUMBER	DESCRIPTION	INCLUDED
ISL36356A-APDK-EVAL	WLAN Evaluation Kit	1 AP 1 PC card

Packaging



FIGURE 1. SAMPLE PLASTIC ENCLOSURE

Features

- Supports the lEEE802.11b Direct Sequence Specification
- FCC Certified Under Part 15 to Operate in 2.4GHz ISM Band
- ETSI EN 300 328 parts 1 and 2 and
- ETSI EN 301 489 parts 1 and 17 Certified
- Supports All Features Required for Wi-Fi™ Compliant Access Points
- Support for 11, 5.5, 2 and 1Mbps Data Rates
- Supports Dual Antenna Diversity
- Supports Short Preamble
- Advanced RAKE Receiver Design with Decision Feedback Equalizer
- Provided Wired ethernet (802.3) connection supports both 10/100BaseT speeds
- Open Source Linux operating system
- Wi-Fi Protected Access (WPA) as well as Wired Equivalent Privacy (WEP) 64&128
- 802.1x Security
- Wizard for Automated IP Configuration
- Wireless Distribution System (WDS) provides repeater and bridging functionality

References

For Intersil documents available on the internet, see web site http://www.intersil.com/

[1] *TB337 Tech Brief*, Intersil Corporation, “A Brief Tutorial on Spread Spectrum and Packet Radio”.

[2] *AN9850 Application Note*, Intersil Corporation, “Complementary Code Keying Made Simple”.

[3] *AN9829 Application Note*, Intersil Corporation, “Brief Tutorial on IEEE802.11 Wireless LANs”.

[4] *AN9820 Application Note*, Intersil Corporation, “A Condensed Review of Spread Spectrum Techniques for ISM Band Systems”.

[5] 555006, Intersil Corporation, "The uClinux Development Environment".

[6] 555007, Intersil Corporation, "Porting Guide for the Intersil Access Point".

[7] 555012, Intersil Corporation, "Architecture of a Linux based Intersil AP".

[8] 555050, Intersil Corporation, “MVC Software Interface Manual”.

[9] 555053, Intersil Corporation, “AP Developer's Kit End User Manual”.

[10] 555051, Intersil Corporation, “AP Developer’s Kit Customization - User’s Manual”.

[11] AN1007, Intersil Corporation, “Introduction to the Wireless Distribution System (WDS) and Features”.

[12] 555029, Intersil Corporation, “Reference Manual APDK Web Server Interface Design”.

Further information can be found in the following:

uClinux homepage: http://www.uclinux.org/

CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.
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Absolute Maximum Ratings

Supply Voltage . . . . . -0.3V to 7.5V (Max)
Storage Temperature (Note 1) . . . . . -20^oC to 85^oC

Operating Conditions

Temperature Range . . . . . $0^oC \le T_A \le 50^oC$
Supply Voltage Range . . . . . 4.5V to 5.5V

Caution: These are the absolute maximum ratings for the product. Exceeding these limits could cause permanent damage to the AP.

NOTE:

1. All temperature references refer to ambient conditions.

Electrical Specifications

Test Conditions: Supply Voltage (V_{CC}) = 5V, Ambient Temperature (T_A) = 25^oC, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
CURRENT CONSUMPTION						
Initialization Current	I_{CC}		-	517	-	mA
Continuous Transmit Mode	I_{CC}		-	670	-	mA
Continuous Receive Mode	I_{CC}	Receiving Valid Packets	-	516	-	mA
RF SYSTEM SPECIFICATIONS						
Transmitter Power Output	P_{out}		14.8	16.2	17.0	dBm
Receive Sensitivity	RX_S	1Mbps, BER 8 E-5	-	-93 (Note 2)	-	dBm
		2Mbps,BER 8 E-5	-	-89 (Note 2)	-	dBm
		5.5Mbps,BER 8 E-5	-	-87 (Note 2)	-	dBm
		11Mbps, BER 8 E-5	-	-83 (Note 2)	-	dBm
Multipath Delay Spread using Naftali model	T_{DELAY}	2Mbps,BER 8 E-5	-	>290	-	ns
		5.5Mbps, BER 8 E-5	-	200	-	ns
		11Mbps, BER 8 E-5	-	105	-	ns
Maximum Receive Level	RX_MAX	BER 8 E-5	-3	>2	-	dBm
Third Order Intercept Point (Input)	IIP3_90	-90 dBm input	-	-3	-	dBm
	IIP3_25	-25 dBm input	-	+20	-	dBm
Carrier Suppression	TX_sup	Test Mode	-	43	-	dB
Image Rejection	IR	BER 8E-5	-	65	-	dB
IF Rejection	IFR	BER 8E-5	60	66	-	dB
Adjacent Channel Rejection (Note 3)	ACR	BER 8E-5	-	35	-	dB
Data Rate (Physical Layer)	Rate		-	1, 2, 5.5 and 11	-	Mbps

NOTES:

2. Measurements done on antenna port 1. Antenna port 2, 1 to 2 dB better performance.
3. The adjacent channel measurement is carried out on two antennas separated by 25MHz (five channels). The -70dBm desired signal and variable strength jammer are both 11Mbps DSSS data transmissions. The jammer is a continuous waveform with -40dBc first sidelobes.

Functional Overview

The WLAN Access Point is designed to operate in the 2.4GHz ISM frequency band, channels 1 to 11, as specified by the FCC in the USA. The AP will also operate on channels 12 through 14, where permitted by local regulatory authorities. Radio equipment must be certified in a country prior to use. Refer to Table 4 for a list of countries and agencies that have approved the ISL36356A-APDK for operation.

The Intersil PRISM II Chip Set allows for high level integration; providing reduced size, increased throughput, improved radio performance and faster time to market. The WLAN Access Point implements Direct Sequence Spread Spectrum DSSS technology that provides superior noise and signal jamming immunity; including less severe impact from unintentional radiators such as microwave ovens. By using an Access Point, the wireless LAN can be set up to allow an even greater number of users to interconnect, and to increase the coverage area. The wireless LAN can be easily connected into an existing wired LAN, allowing for easy expansion of the service.

The ISL3856 Media Access Controller (MAC) Protocol Handler

The ISL3856 ARM940 based MAC Processor and the MAC Virtual Coprocessor (MVC) firmware are responsible for running the IEEE802.11 protocol in the WLAN AP. The MVC acts as a software emulated coprocessor to the ARM940 and runs completely separated from the operating system. It provides an abstraction layer of the underlying hardware to the operating system via a well-defined interface.

The MVC supports the following 802.11 functions:

- CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) with Random Backoff
- WEP Security
- Short/Long Preamble with multirate
- RTS/CTS Handshake (Ready To Send/Clear To Send)
- MAC Level Acknowledgments (Media Access Control)
- Re-Transmission of Unacknowledged Frames
- Duplicate Detection and Rejection
- Broadcast and Multicast Frames
- Fragmentation and Re-Assembly
- Supports clients Power save mode
- Timestamp Synchronization
- DCF (Distributed Coordination Function)

The Linux Operating System

The ARM940 based MAC processor hosts a complete Open Source Linux operating system, offering a flexible and extensible platform for feature development. Due to the large availability of different Linux based applications in the Open Source community, it is easy to add new features to the AP, reducing time to market.

A special embedded version of the Linux operating system, uClinux, is running on the ISL3856. It is tailored to run on the ARM940 processor and optimized for size. The uClinux Application Programmers Interface (API) is the same as the standard Linux API. The ISL36356A platform offers the following basic functions:

- DHCP client/server
- Configuration via Web Interface and SNMP
- Simple and Failsafe Firmware Upgrade via Web Interface
- Wi-Fi Protected Access (WPA)
- 802.1x Security
- Wireless Distribution System
- Routing, NAPT and firewall support
- PPPoE
- VPN Passthrough (PPTP)
- 802.1d Spanning Tree Protocol (STP)

Adding features to the development platform can be done by taking applications that are available in the Open Source community and port them to the platform. Porting documentation is available to assist in this task. Applications can also be made from scratch, so they can be kept closed source.

The table below lists the resources that are available for adding new applications to the basic design. In normal operation, approximately 50% of the processor cycles of the ARM940 are consumed by the MVC. The remaining capacity is available for Linux and the applications. Because all applications are stored in Flash in a compressed format, the available Flash is calculated for both compressed and uncompressed files.

TABLE 2. AVAILABLE RESOURCES

MEMORY CONFIGURATION	AVAILABLE RAM	AVAILABLE FLASH (COMPRESSED / UNCOMPRESSED)
2Mbyte Flash 8Mbyte RAM	~1.2Mbyte	~16kbyte / 32kbyte
4Mbyte Flash 16Mbyte RAM	~9.2Mbyte	~2.0Mbyte / 4.0Mbyte

For starting development on the Linux based platform, a complete development environment is shipped with the product, including documentation describing the setup of a development system.

The complete hardware and software of the system are pretested which ensures a stable development platform.

Configuration Wizard

To ease the process of configuring the Access Point, a Microsoft Windows 95, 98, 2000, NT, XP wizard is included that can be customized to fit specific needs. It automatically detects an AP in the network, even if it is misconfigured, and can configure the IP settings in all common environments (DHCP, auto IP and fixed IP). After the IP settings are configured correctly, it starts the Web interface to finish the configuration.

WPA Overview

WiFi Protected Access (WPA) provides two security enhancements to wireless LANs: improved data encryption and user authentication.

To improve data encryption, WPA uses a Temporal Key Integrity Protocol (TKIP). This protocol provides per-packet key mixing, a message integrity check (MIC) called Michael, an extended initialization vector (IV) with sequencing rules, and a re-keying mechanism.

For user authentication, WPA implements 802.1X and the Extensible Authentication Protocol (EAP) to provide a framework for strong user authentication. This framework utilizes a central authentication server, such as RADIUS, to authenticate each user on the network before they join it, and also employs "mutual authentication" so that the wireless user does not accidentally join a rogue network that might steal its network credentials.

In networks in which there is no authentication server or EAP framework, WPA runs in a special Pre-Shared Key (PSK) mode. In this mode, similar to the current WEP environment, a station and access point use the same manually-entered key to establish an association. Once this key is verified, WPA then encrypts frames using TKIP to provide improved security.

Block Diagram

ISL3856 MAC

See “The ISL3856 Media Access Controller (MAC) Protocol Handler” section.

BBP ISL3863

The BaseBand Processor uses CCK modulation and a Rake architecture to reduce the effects of multipath. This reduces the error rates in typical office environments to improve overall data throughput.

IF HFA3783

The IF is a linear design with AGC. This permits the use of equalizers in the BBP. An IF overload detector and selectable low gain LNA mode work with the BBP to extend dynamic range without sacrificing sensitivity. The IF LO frequency is generated by an external VCO. Filtering at the IF is done by a SAW BandPass filter.

HFA3683 / HFA3983 RF

The RF IC’s are produced in advanced SiGe technology to realize improvements in integration, performance, and power consumption. Integral PLL’s in both RF and IF parts eliminate the need for an external synthesizer. The HFA3683’s internal LNA noise figure is improved so that an external LNA IC is no longer needed. The chipset is designed so that the parts can be interfaced with few external components.

The RF LO frequency is generated by an external VCO. The PA incorporates an integral power detector that is monitored by the BBP. The BBP controls the IF gain to maintain constant output levels.

Antenna System

A dual spatial integrated antenna system is used to select the most optimal signal. The antennas are sleeved dipoles directly connected to the PCB.

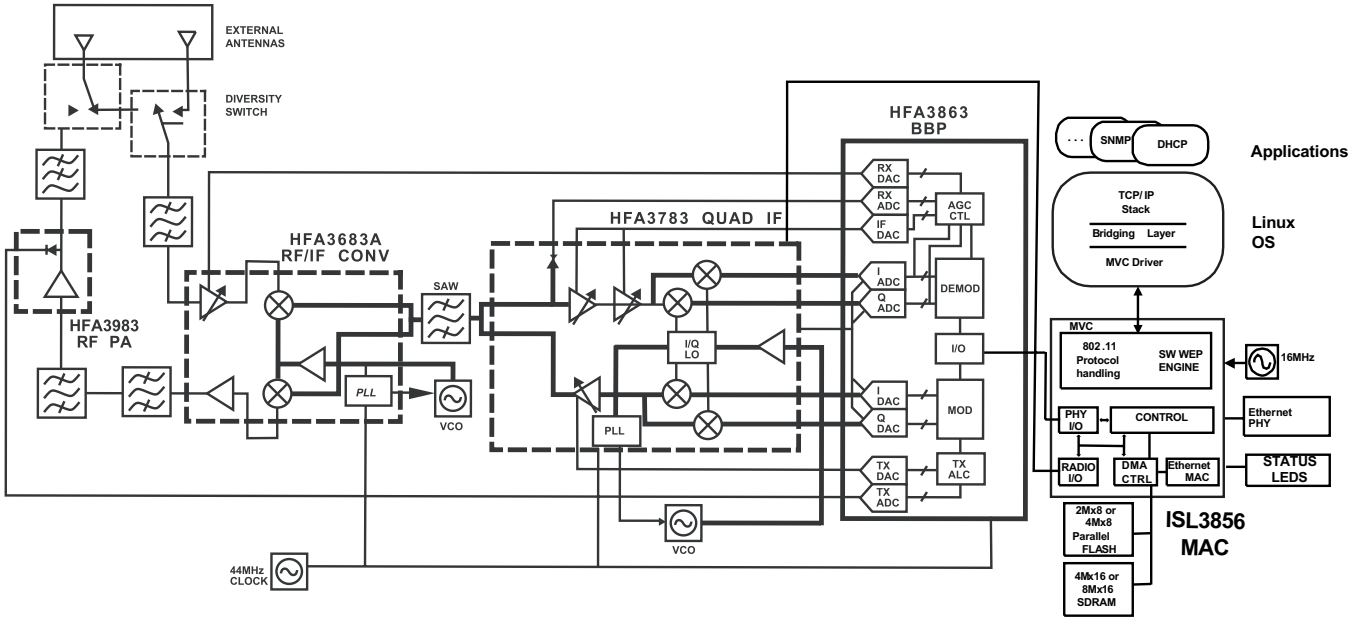


FIGURE 2. ISL36356A-APDK BLOCK DIAGRAM

IEEE802.11 International Agreement and Frequency Assignments

The IEEE802 LAN committee has forged an international agreement providing for wireless data communication standards for the frequency range of 2.4GHz to 2.4835GHz, as allocated by the FCC in the USA, and in the 2.400GHz to 2.497GHz frequency range, as specified by the regulatory authority in Japan. These standards are designed to focus the industry to develop highly integrated, low cost, interoperable WLAN equipment, of which the ISL36356A-APDK is a prime example.

In the U.S., there are 11 channels specified by the FCC in the 2.412GHz to 2.462GHz range. In Japan, channel 14 at 2.484GHz is authorized under ARIB STD-33 and channels 1–13 are authorized under ARIB STD-T66. The ETSI (European) regulatory body conforms to the USA (FCC) channel assignments with the exception that channels 12 and 13 are also allowed. Some countries in Europe, notably France have unique channel restrictions.

Although information contained in Table 3 is deemed to be accurate, local regulatory authorities should be consulted before using such equipment.

The available channels of operation in the 2.4GHz to 2.4835GHz and 2.471GHz to 2.497GHz ranges are as follows:

TABLE 3. IEEE802.11 CHANNELS

CHANNEL NUMBER	CHANNEL FREQUENCY	GEOGRAPHIC USAGE
1	2412MHz	US, CA, EU, JP
2	2417MHz	US, CA, EU, JP
3	2422MHz	US, CA, EU, JP
4	2427MHz	US, CA, EU, JP
5	2432MHz	US, CA, EU, JP
6	2437MHz	US, CA, EU, JP
7	2442MHz	US, CA, EU, JP
8	2447MHz	US, CA, EU, JP
9	2452MHz	US, CA, EU, JP
10	2457MHz	US, CA, EU, JP, FR
11	2462MHz	US, CA, EU, JP, FR
12	2467MHz	EU, FR, JP
13	2472MHz	EU, FR, JP
14	2484MHz	JP (see note)

KEY: US = United States, CA = Canada, EU = European countries (except France), FR = France, JP = Japan

NOTE: channel 14 operation in Japan requires Japan filter to be enabled in order to comply with ARIB STD-33.

The ISL36356A-APDK is shipped with FCC-compliant firmware. In order to ensure regulatory-compliant channel usage in a particular country, special geographic-specific firmware is available for customer production assemblies which restricts channel usage. Examples include ETSI-compliant firmware, etc. For Japan, a Japan filter is implemented to comply with ARIB STD-33. Since the end user does not have the ability to alter this firmware, regulatory compliance is ensured.

Agency and Regulatory Body Approvals

The WLAN Access Point will comply to the standards shown in Table 4:

TABLE 4. COMPLIANCE STANDARDS

COUNTRY	APPROVAL	NOTES
USA	FCC part 15, Sec. 15.247, Sec. 15.107 and 15.109	Grant obtained
Canada	ICAN RSS-210	Designed for compliance
EU & EFTA	EN 60950 EN 301 489-1 V1.2.1 (2000-08) EN 301 489-17 V1.1.1 (2000-09) EN 300 328 Part 1 V1.2.2 (2000-07) EN 300 328 Part 2 V1.1.1 (2000-07)	Certified under RTTE directive
Japan	ARIB STD-T66 ARIB STD-33	Designed for compliance

FCC Information to User

This product does not contain any user serviceable components and is to be used with approved antennas only. Any product changes or modifications will invalidate all applicable regulatory certifications and approvals.

FCC Electronic Emission Notices

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC Radio Frequency Interference statement

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

Operation of this equipment in a residential area may cause harmful interference in which case the user will be required to correct the interference at his own expense.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Guidelines for Human Exposure

The EIRP was measured for the lower, middle and highest frequencies used by the transmitter. The results in Table 5 are based on a safe distance between antenna and operator of eight inches.The equipment therefore fulfills the requirements on power density for general population / uncontrolled exposure of 1.0mW/cm^2 and therefore complies with the requirements of FCC Part 15.247 (b) (4) and FCC OET Bulletin 65 including supplements A, B and C.

TABLE 5. POWER DENSITY CALCULATION

	Ch.1	Ch.6	Ch.11
Measured EIRP (mW)	63.8	66.2	69.3
Calculated Power Density (mW/cm2)	0.051	0.053	0.055

WARNING: *Any changes or modifications of equipment not expressly approved by Intersil could void the user's authority to operate the equipment.*

Caution:*To comply with FCC RF exposure limits, a separation distance of at least 20cm must be maintained between the antenna's of this device and all persons.*

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